2022 Diversified Agriculture Poultry Science

Program CIP: 01.0000—Agriculture, General

Direct inquiries to:

Instructional Design Specialist
Research and Curriculum Unit
P.O. Drawer DX
Mississippi State, MS 39762
662.325.2510

Program Supervisor
Office of Career and Technical Education
Mississippi Department of Education
P.O. Box 771
Jackson, MS 39205
601.359.3974

Published by:

Office of Career and Technical Education
Mississippi Department of Education
Jackson, MS 39205

Research and Curriculum Unit
Mississippi State University
Mississippi State, MS 39762

The Research and Curriculum Unit (RCU), located in Starkville, as part of Mississippi State University (MSU), was established to foster educational enhancements and innovations. In keeping with the land-grant mission of MSU, the RCU is dedicated to improving the quality of life for Mississippians. The RCU enhances intellectual and professional development of Mississippi students and educators while applying knowledge and educational research to the lives of the people of the state. The RCU works within the contexts of curriculum development and revision, research, assessment, professional development, and industrial training.

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Acknowledgments

The diversified agriculture poultry science curriculum was presented to the Mississippi State Board of Education on February 17, 2022. The following persons were serving on the state board at the time:

Dr. Carey M. Wright, state superintendent of education
Ms. Rosemary G. Aultman, chair
Mr. Glen East, vice-chair
Dr. Karen Elam
Dr. Angela Bass
Dr. Ronnie McGehee
Dr. Wendi Barrett
Mr. Matt Miller
Mrs. Mary Werner
Mr. Bill Jacobs
Ms. Amy Zhang, student representative
Ms. Micah Hill, student representative

The following Mississippi Department of Education (MDE) and RCU managers and specialists assisted in the development of the poultry science curriculum:

Wendy Clemons, the executive director of the MDE Office of Secondary Education and Professional Development, supported the RCU and teachers throughout the development of the framework and supporting materials.

Dr. Aimee Brown, the state director of the MDE Office of Career and Technical Education (CTE), supported the RCU and teachers throughout the development of the framework and supporting materials.

Courtney McCubbins, a project manager with the RCU, researched and coauthored this framework. helpdesk@rcu.msstate.edu

Special thanks are extended to the educators who contributed teaching and assessment materials that are included in the framework and supporting materials:

James Roberts, Sumrall High School, Sumrall
Mary Helen Lett, Forrest County Agricultural High School, Brooklyn
Scott Breedlove, Union High School, Union

Appreciation is expressed to the following professionals who provided guidance and insight throughout the development process:

Jill Wagner, agricultural education and FFA program supervisor for the MDE Office of CTE

Betsey Smith, the director of the RCU
Sam Watts, the curriculum manager for the RCU
Dr. Jessica Wells, assistant clinical/extension professor, MSU Poultry Science department

Standards

Standards and alignment crosswalks are referenced in the appendix. Depending on the curriculum, these crosswalks should identify alignment to the standards mentioned below, as well as possible related academic topics as required in the Subject Area Testing Program in Algebra I, Biology I, English II, and U.S. History from 1877, which could be integrated into the content of the units. Mississippi's CTE poultry science curriculum is aligned to the following standards:

National Agriculture, Food, and Natural Resources (AFNR) Career Cluster Content Standards

The National AFNR Career Cluster Content Standards were developed by the National Council on Agricultural Education to serve as a guide for what students should know or be able to do through a study of agriculture in Grades 9-12 and two-year postsecondary programs. The standards were extensively researched and reviewed by leaders in the agricultural industry, secondary and postsecondary instructors, and university specialists. The standards consist of a pathway content standard for each of the eight career pathways. For each content standard, performance elements representing major topic areas with accompanying performance indicators were developed. Measurements of assessment of the performance elements and performance indicators were developed at the basic, intermediate, and advanced levels. A complete copy of the standards can be accessed at thecouncil.ffa.org/afnr. The National AFNR Career Cluster Content Standards are copyrighted to the National Council for Agricultural Education and are used by permission.

International Society for Technology in Education Standards (ISTE)

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iste.org

College- and Career-Readiness Standards

College- and career-readiness standards emphasize critical thinking, teamwork, and problem-solving skills. Students will learn the skills and abilities demanded by the workforce of today and the future. Mississippi adopted Mississippi College- and Career-Readiness Standards (MCCRS) to provide a consistent, clear understanding of what students are expected to learn and so teachers and parents know what they need to do to help them.
mdek12.org/oae/college-and-career-readiness-standards

Framework for 21st Century Learning

In defining 21st-century learning, the Partnership for 21st Century Skills has embraced key themes and skill areas that represent the essential knowledge for the 21st century: global awareness; financial, economic, business, and entrepreneurial literacy; civic literacy; health literacy; environmental literacy; learning and innovation skills; information, media, and technology skills; and life and career skills. 21 *Framework Definitions* (2019).
battelleforkids.org/networks/p21/frameworks-resources

Preface

Secondary CTE programs in Mississippi face many challenges resulting from sweeping educational reforms at the national and state levels. Schools and teachers are increasingly being held accountable for providing applied learning activities to every student in the classroom. This accountability is measured through increased requirements for mastery and attainment of competency as documented through both formative and summative assessments. This document provides information, tools, and solutions that will aid students, teachers, and schools in creating and implementing applied, interactive, and innovative lessons. Through best practices, alignment with national standards and certifications, community partnerships, and a hands-on, student-centered concept, educators will be able to truly engage students in meaningful and collaborative learning opportunities.

The courses in this document reflect the statutory requirements as found in Section 37-3-49, *Mississippi Code of 1972*, as amended (Section 37-3-46). In addition, this curriculum reflects guidelines imposed by federal and state mandates (Laws, 1988, Ch. 487, §14; Laws, 1991, Ch. 423, §1; Laws, 1992, Ch. 519, §4 eff. from and after July 1, 1992; Strengthening Career and Technical Education for the 21st Century Act, 2019 [Perkins V]; and Every Student Succeeds Act, 2015).

Mississippi Teacher Professional Resources

The following are resources for Mississippi teachers:

Curriculum, Assessment, Professional Learning

Program resources can be found at the RCU's website, rcu.msstate.edu.

Learning Management System: An Online Resource

Learning management system information can be found at the RCU's website, under Professional Learning.

Should you need additional instructions, call the RCU at 662.325.2510.

Executive Summary

Pathway Description
The diversified agriculture poultry science course is a one-credit course within the diversified agriculture pathway. Students must earn four credits within the diversified agriculture pathway to be a completer. All students must complete principles of agriscience before being allowed to enroll in poultry science. Content in this course includes competencies in poultry production, anatomy and physiology, genetic makeup, reproduction, and hatchery management. Upon completion of this course, students will have learned the basic roles and functions of a career in poultry science and will have gained basic skills required of an entry-level worker in a poultry facility.

College, Career, and Certifications
No national industry-recognized certifications are known to exist at this time in the field of diversified agriculture. Competencies and suggested objectives in this course have been correlated, however, to the National AFNR Career Cluster Content Standards that have been reviewed and endorsed at the national level by the National Council on Agricultural Education.

Grade Level and Class Size Recommendations
It is recommended that students enter this program as 10th-12th graders. Exceptions to this are a district-level decision based on class size, enrollment numbers, student maturity, and CTE delivery method. This is a hands-on, lab- or shop-based course. Therefore, a maximum of 15 students is recommended per class with only one class with the teacher at a time.

Student Prerequisites
For students to experience success in the program, the following student prerequisites are suggested:

1. C or higher in English (the previous year)
2. C or higher in high school-level math (last course taken or the instructor can specify the level of math instruction needed)
3. Instructor approval and TABE reading score (eighth grade or higher)

or

1. TABE reading and math score (eighth grade or higher)
2. Instructor approval

or

1. Instructor approval

Assessment
The latest assessment blueprint for the curriculum can be found at rcu.msstate.edu/curriculum/curriculumdownload.

Applied Academic Credit
The latest academic credit information can be found at mdek12.org/ese/approved-course-for-the-secondary-schools.

Teacher Licensure
The latest teacher licensure information can be found at mdek12.org/oel/apply-for-an-educator-license.

Professional Learning
If you have specific questions about the content of any of the training sessions provided, please contact the RCU at 662.325.2510.

Course Outlines

One 1-Carnegie Unit Course

This curriculum consists of one 1-credit course.

Diversified Agriculture Poultry Science—Course Code: Insert number here

Unit	Title	Hours
1	Introduction to Poultry Production	10
2	Avian Anatomy and Physiology	20
3	Genetics, Reproduction, and Embryology	20
4	Nutrition and Feed Manufacturing	20
5	Pullet and Hen Production Management	15
6	Hatchery Management	15
7	Market Broiler Management	15
8	Processing	15
9	Immersion Into FFA and Supervised Agricultural Experience (SAE) for All	10
Total		140

Career Pathway Outlook

Overview

The agricultural sciences career cluster covers the broad field of occupations related to the production and use of plants and animals for food, fiber, aesthetic, and environmental purposes. According to the U.S. Department of Agriculture, during the next five years (2020-2025) 59,400 jobs are expected to open in food, agriculture, renewable natural resources, or the environment for graduates with bachelor's or higher degrees in those areas. Almost half of those jobs will be in management and business at 42%; 31% in science, technology, engineering, and math in agriculture; 13% in sustainable food and biomaterials production; and 14% in education, communication, and government services. According to USDA, agriculture, food, and related industries contributed $1.109 trillion to the U.S. gross domestic product (GDP) in 2019. The Mississippi Department of Agriculture and Commerce reports that agriculture is Mississippi's number one industry at $7.35 billion and employing approximately 17.4% of the state's workforce.

Diversified agriculture will target careers at the professional and technical levels in agriculture. Students enrolled in these courses should be better prepared to pursue degrees at the community college and four-year college levels.

Needs of the Future Workforce

Data for this synopsis were compiled from the Mississippi Department of Employment Security (MDES) (2018). Employment opportunities for each of the occupations are listed below:

Table 1.1: Current and Projected Occupation Report

Description	Jobs, 2016	Projected Jobs, 2026	Change (Number)	Change (Percent)	Average Yearly Earnings, 2021
Agricultural Inspectors	350	360	10	2.9%	$42,470
Butchers and Meat Cutters	1,220	1,250	30	2.5%	$27,920
Meat, Poultry, and Fish Cutters and Trimmers	6,650	6,730	80	1.2%	$29,880
Slaughterers and Meat Packers	2,560	2,610	50	2.0%	$28,150
Food Processing Workers	950	960	10	1.1%	$28,620
Veterinarians	520	620	100	19.2%	$89,610
Veterinary Technologists and Technicians	570	690	120	21.1%	$34,940
Veterinary Assistants and Laboratory Animal Caretakers	860	1,040	180	20.9%	$27,480

Source: Mississippi Department of Employment Security; mdes.ms.gov (2021).

Perkins V Requirements and Academic Infusion
The poultry science curriculum meets Perkins V requirements of introducing students to and preparing them for high-skill, high-wage occupations in poultry science fields. It also offers students a program of study, including secondary, postsecondary, and institutions of higher learning courses, that will further prepare them for careers in the agriculture industry. Additionally, this curriculum is integrated with academic college- and career-readiness standards. Lastly, it focuses on ongoing and meaningful professional development for teachers as well as relationships with industry.

Transition to Postsecondary Education
The latest articulation information for secondary to postsecondary can be found at the Mississippi Community College Board website, mccb.edu.

Best Practices

Innovative Instructional Technologies

Classrooms should be equipped with tools that will teach today's digital learners through applicable and modern practices. The poultry science educator's goal should be to include teaching strategies that incorporate current technology. To make use of the latest online communication tools—wikis, blogs, podcasts, and social media platforms, for example—the classroom teacher is encouraged to use a learning management system that introduces students to education in an online environment and places more of the responsibility of learning on the student.

Differentiated Instruction

Students learn in a variety of ways, and numerous factors—students' background, emotional health, and circumstances, for example—create unique learners. By providing various teaching and assessment strategies, students with various learning preferences can have more opportunities to succeed.

CTE Student Organizations

Teachers should investigate opportunities to sponsor a student organization. The National FFA Organization is the student organization for this pathway and will foster the types of learning expected from the poultry science curriculum. FFA provides students with growth opportunities and competitive events and opens the doors to the world of agriculture and scholarship opportunities.

Cooperative Learning

Cooperative learning can help students understand topics when independent learning cannot. Therefore, you will see several opportunities in the poultry science curriculum for group work. To function in today's workforce, students need to be able to work collaboratively with others and solve problems without excessive conflict. The poultry science curriculum provides opportunities for students to work together and help each other complete complex tasks. There are many field experiences within the poultry science curriculum that will allow and encourage collaboration with professionals currently in the poultry science industry.

Work-Based Learning

Work-based learning is an extension of understanding competencies taught in the poultry science classroom. This curriculum is designed in a way that necessitates active involvement by the students in the community around them and the global environment. These real-world connections and applications link all types of students to knowledge, skills, and professional dispositions. Work-based learning should encompass ongoing and increasingly more complex involvement with local companies and agriscience professionals. Thus, supervised collaboration and immersion into the agriculture industry around the students are keys to students' success, knowledge, and skills development.

Professional Organizations

American Association for Agricultural Education (AAAE)
aaaeonline.org

Association for Career and Technical Education (ACTE)
acteonline.org

Mississippi ACTE
mississippiacte.com

Mississippi FFA/Mississippi Association of Vocational Agriculture Teachers (MAVAT)
mississippiffa.org

National Association of Agricultural Educators (NAAE)
naae.org

National FFA Organization
ffa.org

Using This Document

Competencies and Suggested Objectives
A competency represents a general concept or performance that students are expected to master as a requirement for satisfactorily completing a unit. Students are expected to receive instruction on all competencies. The suggested objectives represent the enabling and supporting knowledge and performances that will indicate mastery of the competency at the course level. Teachers are welcome to teach the competencies in other ways than the listed objectives if it allows for mastery of the competencies. Teachers are also allowed to teach the units and competencies in the order that they prefer, as long as they teach necessary material allotted for that specific course or credit they are teaching at the time.

Teacher Resources
Teacher resources for this curriculum may be found in multiple places. Many program areas have teacher resource documents that accompany the curriculum and can be downloaded from the same site as the curriculum. The teacher resource document contains references, lesson ideas, websites, teaching and assessment strategies, scenarios, skills to master, and other resources divided by unit. This document could be updated periodically by RCU staff. Please check the entire document, including the entries for each unit, regularly for new information. If you have something you would like to add or have a question about the document, call or email the RCU's instructional design specialist for your program. The teacher resource document can be downloaded at rcu.msstate.edu/curriculum/curriculumdownload.aspx. All teachers should request to be added to the Canvas Resource Guide for their course. This is where all resources will be housed in the future if they are not already. To be added to the guide, send a Help Desk ticket to the RCU by emailing helpdesk@rcu.msstate.edu.

Perkins V Quality Indicators and Enrichment Material
Some of the units may include an enrichment section at the end. If the diversified agriculture poultry science program is currently using the Mississippi Career Planning and Assessment System (MS-CPAS) as a measure of accountability, the enrichment section of material will not be tested. If this is the case, it is suggested to use the enrichment material when needed or desired by the teacher and if time allows in the class. This material will greatly enhance the learning experiences for students. If, however, the diversified agriculture poultry science program is using a national certification, work-based learning, or other measure of accountability that aligns with Perkins V as a quality indicator, this material could very well be tested on that quality indicator. It is the responsibility of the teacher to ensure all competencies for the selected quality indicator are covered throughout the year.

Unit 1: Introduction to Poultry Production

Competencies and Suggested Objectives

1. Discuss the structure of the poultry industry. DOK 1
   a. Trace the history of the poultry industry.
   b. Describe the concept of vertical integration as it applies to the poultry industry.
      - Primary breeders
      - Feed mills
      - Breeders
      - Hatcheries
      - Grow out farms
      - Processing plants
      - Further processing
      - Transportation
      - Marketing
   c. Explore the various poultry companies in Mississippi.
      - Facilities, size, and location
      - Mission and vision
      - Type of company
      - Products
      - Markets
      - Sales volume
      - Grower requirements/policies
   d. Identify careers and leadership opportunities in the poultry industry.

2. Discuss the types of poultry operations. DOK 1
   a. Describe the broiler industry.
      - Hatcheries
      - Pullets/broiler breeders
      - Broilers
   b. Describe the layer industry.
      - In-line
      - Off-line
   c. Describe niche markets in the poultry industry and develop a backyard flock management plan.
      - Quail
      - Turkey
      - Duck
      - Geese

Unit 2: Avian Anatomy and Physiology

Competencies and Suggested Objectives

1. Explain the anatomy of the avian species as it relates to production management. DOK 2
   a. Describe the integumentary system.
      - Skin
      - Feathers (i.e., primary and secondary)
   b. Describe the skeletal system of the avian species.
      - Hollow/tubed (i.e., pneumatic) bones (120 bones)
      - Elongated (i.e., fused) bones
      - Joints (e.g., hinged, ball)
      - Medullary bones
      - Fused vertebrae
   c. Distinguish the different types of muscle found within the avian muscular system.
      - Light/white
      - Dark
   d. Assess how the respiratory system functions in the avian species.
      - Lungs
      - Air sacs
      - Respiratory process (i.e., inhalation/exhalation) and rate
   e. Identify the parts, along with their function, in the digestion process.
      - Mouth
      - Esophagus
      - Crop
      - Proventriculus
      - Gizzard
      - Small intestine
      - Ceca
      - Large intestine
      - Cloaca (i.e., excretion process incorporating the urinary system)
      - Vent
   f. Describe the parts and functions of the reproduction process in the avian species.
      - Male
        - Two internal testes
        - Penile organ
        - Spermatozoa
        - Lack of secondary sex glands
      - Female
        - One functioning ovary
        - Oviduct (e.g., infundibulum, magnum, isthmus, uterus, vagina)
   g. Identify characteristics of the circulatory system in the avian species.

- Heart
- Heart rate
- Blood composition
- Spleen
- Function of the blood
- Liver function
- Blood pressure

h. Identify characteristics of the nervous system.
   - Brain
   - Senses

Unit 3: Genetics, Reproduction, and Embryology

Competencies and Suggested Objectives

1. Use physical characteristics of birds to select desirable traits in the commercial poultry industry. DOK 2
   a. Identify desirable bird traits in the commercial poultry industry.
      - Plumage color
      - Meat and/or egg production
      - Hatching egg quality
      - Skin color
   b. Discuss sex-linked traits that can be used to identify desirable traits.
      - Fast and slow feathering

2. Examine the process of avian reproduction. DOK 2
   a. Identify the parts of the female reproductive tract.
      - Ovary
      - Oviduct
      - Five regions (e.g., infundibulum, magnum, isthmus, uterus, vagina)
      - Cloaca
        - Papilla
      - Vent
   b. Identify the parts of the male reproductive system.
      - Testicle
      - Epididymis
      - Vas deferens
      - Cloaca
        - Rudimentary phallus
   c. Summarize the process of egg formation in the female reproductive tract.
      - The ovary releases the ovum.
      - The ovum is captured by the infundibulum (i.e., funnel), where fertilization takes place.
      - The ovum passes into the magnum, where the albumen (i.e., a thick, white membrane) is added.
      - The ovum and the albumen go to the isthmus, where the shell membrane is added.
      - The ovum moves to the uterus (i.e., a thin white, pigmentation and shell), where the shell is formed. This is the longest part of the process.
      - The ovum moves to the vagina, where it is sealed.
      - The egg rotates in the vagina so it can be expelled.
   d. Summarize the stages of embryonic development during incubation.
   e. Compare and contrast natural and artificial incubation.

Unit 4: Nutrition and Feed Manufacturing

Competencies and Suggested Objectives

1. Recognize the importance of nutrition for poultry production. DOK 1
   a. Define nutrition and nutrients.
   b. Identify and describe the importance of the six classes of nutrients.
      - Water
      - Carbohydrates
        - Starch
        - Cellulose
      - Protein
        - Essential amino acids
        - Non-essential amino acids
      - Lipids
      - Vitamins
        - Water soluble
        - Fat soluble
      - Minerals
        - Macrominerals
        - Microminerals
   c. Discuss how nutrient requirements may vary based on various factors.
      - Stage of growth
      - Production goals
      - Type of bird
      - Environment

2. Describe and identify feed ingredients utilized in poultry production. DOK 1
   a. Identify and categorize the nutrients (e.g., types/percentages) provided by specific feed ingredients.
      - Cereal grains (e.g., corn, wheat, barley, rice, etc.)
      - Oilseed meals (e.g., soybean meal, canola meal, peanut meal, flaxseed meal, etc.)
      - Rendered products (e.g., meat and bone meal, feather meal, fish meal, etc.)
      - Co-products
        - Rice (e.g., bran, etc.)
        - Corn-dried distiller's grains and solubles (DDGS)
        - Wheat (e.g., middlings, etc.)
        - Bakery by-products (e.g., cookie, pretzel, etc.)
      - Alternative feed ingredients
        - Sunflower meal

- Sweet potato meal
- Coconut meal
- Algae meal

- Fat sources
  - Poultry fat
  - Corn oil
  - Soybean oil
  - Flaxseed oil
  - Animal/Vegetable fat

b. Identify and categorize feed additives and their purpose.
   - Antibiotics and anticoccidials
     - Antibiotic alternatives and marketing (e.g., probiotics, prebiotics, organic acids, etc.).
   - Exogenous feed enzymes (e.g., Phytase, carbohydrases, etc.).

   Recognize that ingredients vary in quality (i.e., bioavailability).
   - Partitioning of feed energy
     - Gross energy
     - Digestible energy
     - Metabolizable energy
     - Net energy
     - Maintenance vs. production energy
   - Proximate analysis assays
   - Digestibility/growth assays

c. Describe various diet formulation strategies.

3. Describe the feed manufacturing process. DOK 1

a. Understand the different components and functions of the feed manufacturing process.
   - Feed mills
     - History
     - Planning (e.g., location, design, layout, etc.)
     - Quality control (e.g., FSMA, HACCP, etc.)
     - Type (e.g., commercial-integrated vs. multi-species)
   - Receiving and storage
   - Grinding
     - Particle size
     - Roller mill vs. hammer mill
   - Mixers and mixing
     - Horizontal vs. vertical mixer
     - Mixer uniformity
   - Pelleting
     - Conditioner

- Pellet mill
- Coolers
  - Horizontal vs. vertical vs. counterflow
- Post-pellet liquid application equipment
- Crumbler
- Loading and delivery
- Pellet quality
  - Importance
  - Ways to assess (e.g., pellet: fine ratio, New Holmen, K-State Tumbler, etc.)
- Miscellaneous feed equipment
  - Expanders
  - Hygienizers
  - Ripeners
  - Extruders

Unit 5: Pullet and Hen Production Management

Competencies and Suggested Objectives

1. Describe pullet and hen production management**.** DOK 1
   a. Define terms related to pullet and hen production.
      - Layer
      - Pullet
      - Egg strain pullet
      - Feed conversion
      - Stocking density
      - Floor space
      - Brooding
      - Litter
      - Feeders
      - Waterers
      - Ventilation
      - Water management
      - Cooling systems
      - Mortality
      - Incineration
      - Incinerator
      - Composting
      - De-caking
      - Drippers
      - Radiant heat
      - Warm air
      - Ammonia buildup
      - Growth rate
      - Contracts
      - Shanks
      - Crooked shanks
      - Unhealed navel
      - Vents
      - Navel infection
      - Mushiness
      - Crossed beak
      - Grower count
      - Mortality rate
      - Daily checklist
      - Nest boxes
      - Cage nests
      - Vertical slat tables
      - Spiking (rooster-hen ratio)
      - Replacement pullet
      - Commercial egg layer
      - Broiler breeder
      - Tunnel house
      - Grow-out period
      - Behavioral characteristics
      - Lighting

   b. Discuss how a grower becomes a contract pullet and hen producer with an integrated poultry company.
   c. Describe the purpose of producing pullets and hens.
   d. Distinguish the three types of pullet and hen production.
      - Replacement pullet
      - Commercial egg layers
        - Egg collecting, processing, grading, and handling
          - In-line vs. off-line
        - Types of production/housing
          - Organic, free-range, cage-free, enriched cage, commercial cage, aviaries, and so forth
          - Consumer demands
      - Broiler breeders
        - Egg collection

- Types of production/housing
  - Organic, free-range, commercial, antibiotic-free (ABF), no antibiotics ever (NAE), and so forth

e. Discuss care and maintenance of the flock during the housing and rearing process.
- Ventilation
- Daily routine
- Brooding (i.e., pullets)
- Lighting
- Feed and feeding
- Water source and availability
- Litter quality
- Record keeping and performance reporting

Unit 6: Hatchery Management

Competencies and Suggested Objectives

1. Describe a hatchery**.** DOK 1
   a. Define terms related to hatchery management.
      - Hatchery
      - Incubator
      - Percent fertility
      - Percent hatchability
      - Humidity
      - Automatic egg turner
      - Temperature control
      - Candling
      - Egg rotation
      - Vaccination
      - Sanitizing
      - Biosecurity
      - Setter tray washer
      - Synchronization
      - Acclimation
      - Egg storage
      - Setting
      - Incubation
      - Setter
      - Hatcher
      - Egg age correction
      - Egg size correction
      - Setting time correction
      - Vacuum handling

   b. Compare and contrast the characteristics of different types of hatchery systems used in poultry production.
      - Multi-stage rack
      - Multi-stage buggy
      - Single-stage buggy
      - Tabletop incubator

   c. Describe the steps in the hatchery process.
      - Storing
      - Setting
      - Hatching
      - Transferring
      - Processing the chicks (i.e., sexing, vaccinating)
      - Transporting

2. Discuss the factors that influence percent hatchability at the breeder farm and the hatchery. DOK 2
   a. Explain the factors that influence percent hatchability at the breeder farm.
      - Bird nutrition
      - Egg fertility
      - Disease control
      - Egg handling
      - Egg sanitation
      - Egg storage

   b. Explain the factors that influence percent hatchability at the hatchery.
      - Egg incubation

- Chick handling
- Disease control
- Egg handling
- Egg sanitation
- Egg storage

3. Assess the factors that influence the incubation of eggs. DOK 3
   a. Discuss the importance of proper egg storage prior to setting.
      - Maintaining proper temperature
      - Storage time
      - Gas exchange
      - Air quality
   b. Explain how temperature affects egg incubation.
   c. Explain how the age of an egg affects egg incubation.
   d. Explain how the size of an egg affects egg incubation.
   e. Calculate the setting time for an egg based upon temperature, age, and size.
   f. Create a schedule for egg incubation and hatching.
4. Assess management practices associated with hatchery facilities. DOK 3
   a. Explain the processes of waste disposal in a hatchery according to local, state, and federal guidelines.
   b. Investigate potential biosecurity issues in a hatchery.
      - Sanitation
      - Limited access to the facility
      - Farm-to-hatchery disease transfer risk
   c. Explain the purposes of recordkeeping in a hatchery.
      - Assist in daily/weekly management decisions.
      - Monitor and control egg and chick flow through the hatchery.
      - Assist in determining overall hatchery policy.
   d. Investigate industry safety standards associated with hatchery facilities.

Enrichment

Activity: Create a schedule for egg incubation and hatching.

Stored eggs—For each day of storage beyond 6 days, extend the incubation time by 1 hour. Example: If an egg is stored for 11 days (6 days + 5 days), then add 5 hours of time to the incubation schedule.

Egg size—Larger eggs take longer to incubate. For each 0.10 oz past 2.1 oz, add 30 minutes to the incubation time. Example: 4-day-old eggs from 32-week-old breeders normally require 21 days and 6 hours (510 hours total) to incubate.

How much time is required to incubate 10-day-old eggs from a 60-week-old flock with an average egg size of 2.7 oz?

Answer: Egg size correction is .06 oz difference x .5 hours/0.1 oz = 3 hours.
Egg age correction is 4 days extended storage x 1 hour/day of extended storage = 4 hours.
Total setting time correction is 3 hours + 4 hours = 7 hours.
510 hours + 7 hours = 517 hours.

Unit 7: Market Broiler Management

Competencies and Suggested Objectives

1. Describe market broiler management**.** DOK 1
   a. Define terms related to broiler production.
      - Broiler
      - Feed conversion
      - Stocking density
      - Floor space
      - Brooding
      - Litter
      - Feeders
      - Waterers
      - Ventilation
      - Water management
      - Cooling systems
      - Mortality
      - Incineration
      - Incinerator
      - Composting
      - De-caking
      - Drippers
      - Radiant heat
      - Warm air
      - Ammonia buildup
      - Lighting
      - Tunnel house
      - Grow-out period
      - Behavioral characteristics
      - Growth rate
      - Contracts
      - Shanks
      - Crooked shanks
      - Unhealed navel
      - Vents
      - Navel infection
      - Mushiness
      - Crossed beak
      - Grower count
      - Mortality rate
      - Daily checklist

   b. Discuss how a grower becomes a contract broiler producer with an integrated poultry company.
   c. Understand the purpose of broiler production.
   d. Analyze the characteristics of quality chicks grown in a broiler facility.
      - Produced from clean stock (i.e., *Mycoplasma gallisepticum* (MG) and/or *Mycoplasma synoviae* (MS) negative)
      - Cleanly hatched from one flock source
      - Weigh almost 8.75 lbs per hundred chicks (0.25 oz per chick)
      - Uniform in size and color
      - Well-dried, fluffed, and with long down
      - Alert and active with round, bright eyes and bright, waxy shanks
      - Free of unhealed navels, navel infection, mushiness, and pasted up vents
      - Free of deformities (e.g., crooked shanks, seven toes, defective head or eyes, crossed beaks, etc.)

   e. Calculate the stocking density of a broiler house based upon company guidelines, the size of the house, and the length of the grow-out period.

2. Describe the broiler grow-out process. DOK 1
   a. Discuss the process of preparing to receive chicks in a broiler house.

- Step 1—Develop a maintenance schedule and make repairs as needed.
- Step 2—De-cake the litter.
- Step 3—Clean and disinfect the broiler house.
- Step 4—Add and level litter.
- Step 5—Clean, disinfect, and place feed pans and water drippers.
- Step 6—Set up brooders and test the heat.
- Step 7—Check/test the water system.
- Step 8—Test generators, fans, and the cooling system.
- Step 9—Preheat the house before the chicks arrive.
- Step 10—Place feed and water prior to arrival.

b. Discuss care and maintenance of the flock during the grow-out process.
- Ventilation
- Daily routine
- Brooding
- Lighting
- Feed and feeding
- Water source and availability
- Litter quality
- Recordkeeping and performance reporting

c. Interpret a grow-out summary.

3. Assess management practices associated with broiler production facilities. DOK 3

a. Explain water, nutritional, and feed requirements in broiler production.
- Water requirements
- Feed form
- Feed conversion

b. Calculate feed conversion ratios for broilers.

c. Examine the causes and effects of mortality in broiler production.
- Causes—dehydration, starve-outs, infections, growth-related factors
- Effects—mortality rate, production efficiency

d. Calculate mortality rate.

e. Discuss composting guidelines in a broiler house according to local, state, and federal regulations.

f. Identify potential biosecurity issues in a broiler production facility.
- Sanitation
- Limited access to the facility
- Hatchery-introduced infection risk

g. Discuss the purposes of recordkeeping in broiler production.
- Assists in daily/weekly management decisions
- Monitoring feed conversions, performance, and profitability
- Monitoring mortality rate and risk management.
- Assists in determining overall broiler production policies
- Better programming of automated facilities

Unit 8: Processing

Competencies and Suggested Objectives

1. Describe the steps of processing. DOK 1
   a. Identify the steps of processing and what happens at each stage.
      - Preslaughter phase
        - Feed and water withdrawal
        - Catching
        - Live haul
        - Holding at the processing plant
        - Unloading
      - First processing
        - Shackling
        - Stunning
        - Harvesting
        - Scalding
        - Picking
        - Evisceration
          - Preen gland removal
          - Vent cutter
          - Opener
          - Eviscerator
          - Inspection giblet harvesting
          - Cropper
          - Lung remover
          - Neck breaker
          - Inside-outside wash
          - Chilling
      - Second processing
        - Cut up
        - Debone
        - Portion control
      - Further processing
      - Rendering and waste management

2. Identify laws and policies within food safety and regulations. DOK 1
   a. List laws and policies associated with poultry science.
      - Good Manufacturing Practice (GMP)
      - Hazard Analysis Critical Control Point (HACCP)
      - U.S. Food and Drug Administration (FDA)
      - U.S. Department of Agriculture (USDA)
        - Grading
      - Industry safety standards

3. Describe the marketing goals of different types of production. DOK1
   a. List and describe different types of marketing goals.
      - Free-range
      - Organic
      - Antibiotic free (ABF)
      - Consumer demand

Unit 9: Immersion Into FFA and Supervised Agricultural Experience (SAE) for All

Competencies and Suggested Objectives

1. Participate in local, state, and/or national FFA activities that provide opportunities for leadership development and career exploration. DOK 3
   a. Actively participate in FFA activities.
      - Leadership Development Events (LDEs)
      - Career Development Events (CDEs)
        - Poultry Science
      - Leadership retreats or conferences
      - Industry-related seminars, workshops, or conferences
      - Other related FFA activities

2. Apply concepts learned from the school-based agricultural education program to continue the progression of immersion SAEs. DOK 4
   a. Redefine and adjust requirements of agreements between the student, parents, supervisor, and/or employer.
   b. Update SAE records using an electronic/computer-based system of record keeping.
      - SAE program goals
      - Student inventory related to the SAE program
      - Expense records
      - Income/gift and scholarship records
      - Skill-attainment records
      - Leadership-activity records and participation in FFA activities
      - Community service hours
   c. Complete degree and proficiency award applications as they apply to the SAE.

Student Competency Profile

Student's Name: _____

This record is intended to serve as a method of noting student achievement of the competencies in each unit. It can be duplicated for each student, and it can serve as a cumulative record of competencies achieved in the course.

In the blank before each competency, place the date on which the student mastered the competency.

Unit 1: Introduction to Poultry Production		
	1.	Discuss the structure of the poultry industry.
	2.	Discuss the types of poultry operations.
Unit 2: Avian Anatomy and Physiology		
	1.	Explain the anatomy of the avian species as it relates to production management.
Unit 3: Genetics, Reproduction, and Embryology		
	1.	Use physical characteristics of birds to select desirable traits in the commercial poultry industry.
	2.	Examine the process of avian reproduction.
Unit 4: Nutrition and Feed Manufacturing		
	1.	Recognize the importance of nutrition for poultry production.
	2.	Describe and identify feed ingredients utilized in poultry production.
	3.	Describe the feed manufacturing process.
Unit 5: Pullet and Hen Production Management		
	1.	Describe pullet and hen production management.
Unit 6: Hatchery Management		
	1.	Describe a hatchery.
	2.	Discuss the factors that influence percent hatchability at the breeder farm and the hatchery.
	3.	Assess the factors that influence the incubation of eggs.
	4.	Assess management practices associated with hatchery facilities.
Unit 7: Market Broiler Management		
	1.	Describe market broiler management.
	2.	Describe the broiler grow-out process.
	3.	Assess management practices associated with broiler production facilities.

Unit 8: Processing		
	1.	Describe the steps of processing.
	2.	Identify laws and policies within food safety and regulations.
	3.	Describe the marketing goals of different types of production.
Unit 9: Immersion Into FFA and Supervised Agricultural Experience (SAE) for All		
	1.	Participate in local, state, and/or national FFA activities that provide opportunities for leadership development and career exploration.
	2.	Apply concepts learned from the school-based agricultural education program to continue the progression of immersion SAEs.

Source: *Miss. Code Ann. §§ 37-1-3 and 37-31-103*

Appendix: Industry Standards

Framework for AFNR Content Standards and Performance Elements Crosswalk for Diversified Agriculture Poultry Science										
	Unit	1	2	3	4	5	6	7	8	9
AFNR										
ABS- Agribusiness Systems		X					X	X	X	X
AS- Animal Systems		X	X	X	X	X	X	X	X	X
BS- Biotechnology			X	X		X	X	X	X	
CRP- Career Ready Practices		X	X	X	X	X	X	X	X	X
CS- AFNR Cluster Skill		X	X	X	X	X	X	X	X	X
ES- Environmental Service Systems										
FPP- Food Products and Processing Systems					X	X	X	X	X	
NRS- Natural Resource Systems										
PS- Plant Systems										
PST- Power, Structural, and Technical Systems						X	X	X	X	

AFNR Pathway
Content Standards and Performance Elements

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ABS AGRIBUSINESS SYSTEMS
AS ANIMAL SYSTEMS
BS BIOTECHNOLOGY
CRP CAREER READY PRACTICES
CS AGRICULTURE FOOD AND NATURAL RESOURCES CLUSTER SKILL
ES ENVIRONMENTAL SERVICE SYSTEMS
FPP FOOD PRODUCTS AND PROCESSING SYSTEMS
NRS NATURAL RESOURCE SYSTEMS
PS PLANT SYSTEMS
PST POWER, STRUCTURAL, AND TECHNICAL SYSTEMS

Agribusiness Systems Career Pathway Content Standards

The Agribusiness Systems (ABS) Career Pathway encompasses the study of agribusinesses and their management including, but not limited to, record keeping, budget management (cash and credit), and business planning, and sales and marketing. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the planning, development, application and management of agribusiness systems in AFNR settings.

Within each pathway, the standards are organized as follows:

- ***Common Career Technical Core (CCTC) Standards*** – These are the standards for Agribusiness Systems (AG-ABS) from the 2012 version of the Common Career and Technical Core Standards, which are owned by the National Association of State Directors of Career and Technical Education/National Career Technical Education Foundation and are used here with permission. These statements define what students should know and be able to do after completing instruction in a program of study for this pathway.
- ***Performance Indicators*** – These statements distill each CCTC Standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related CCTC Standard at the conclusion of a program of study in this area.

ABS.01. CCTC Standard: Apply management planning principles in AFNR businesses.

ABS.01.01. Performance Indicator: Apply micro- and macroeconomic principles to plan and manage inputs and outputs in an AFNR business.

ABS.01.02. Performance Indicator: Read, interpret, evaluate and write statements of purpose to guide business goals, objectives and resource allocation.

ABS.01.03. Performance Indicator: Devise and apply management skills to organize and run an AFNR business in an efficient, legal and ethical manner.

ABS.01.04. Performance Indicator: Evaluate, develop and implement procedures used to recruit, train and retain productive human resources for AFNR businesses.

ABS.02. CCTC Standard: Use record keeping to accomplish AFNR business objectives, manage budgets and comply with laws and regulations.

ABS.02.01. Performance Indicator: Apply fundamental accounting principles, systems, tools and applicable laws and regulations to record, track and audit AFNR business transactions (e.g., accounts, debits, credits, assets, liabilities, equity, etc.).

ABS.02.02. Performance Indicator: Assemble, interpret and analyze financial information and reports to monitor AFNR business performance and support decision-making (e.g., income statements, balance sheets, cash-flow analysis, inventory reports, break-even analysis, return on investment, taxes, etc.).

ABS.03. CCTC Standard: Manage cash budgets, credit budgets and credit for an AFNR business using generally accepted accounting principles.

ABS.03.01. Performance Indicator: Develop, assess and manage cash budgets to achieve AFNR business goals.

ABS.03.02. Performance Indicator: Analyze credit needs and manage credit budgets to achieve AFNR business goals.

ABS.04. CCTC Standard: Develop a business plan for an AFNR business.

ABS.04.01. Performance Indicator: Analyze characteristics and planning requirements associated with developing business plans for different types of AFNR businesses.

ABS.04.02. Performance Indicator: Develop production and operational plans for an AFNR business.

ABS.04.03. Performance Indicator: Identify and apply strategies to manage or mitigate risk.

ABS.05. CCTC Standard: Use sales and marketing principles to accomplish AFNR business objectives.

ABS.05.01. Performance Indicator: Analyze the role of markets, trade, competition and price in relation to an AFNR business sales and marketing plans.

ABS.05.02. Performance Indicator: Assess and apply sales principles and skills to accomplish AFNR business objectives.

ABS.05.03. Performance Indicator: Assess marketing principles and develop marketing plans to accomplish AFNR business objectives.

Animal Systems Career Pathway Content Standards

The Animal Systems (AS) Career Pathway encompasses the study of animal systems, including content areas such as life processes, health, nutrition, genetics, and management and processing, as applied to small animals, aquaculture, exotic animals, livestock, dairy, horses and/or poultry. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the development, application and management of animal systems in AFNR settings.

Within each pathway, the standards are organized as follows:

- ***Common Career Technical Core (CCTC) Standards*** – These are the standards for Animal Systems (AG-AS) from the 2012 version of the Common Career and Technical Core Standards, which are owned by the National Association of State Directors of Career and Technical Education/National Career Technical Education Foundation and are used here with permission. These statements define what students should know and be able to do after completing instruction in a program of study for this pathway.
- ***Performance Indicators*** – These statements distill each CCTC Standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related CCTC Standard at the conclusion of a program of study in this area.

AS.01. CCTC Standard: Analyze historic and current trends impacting the animal systems industry.

AS.01.01. Performance Indicator: Evaluate the development and implications of animal origin, domestication and distribution on production practices and the environment.

AS.01.02. Performance Indicator: Assess and select animal production methods for use in animal systems based upon their effectiveness and impacts.

AS.01.03. Performance Indicator: Analyze and apply laws and sustainable practices to animal agriculture from a global perspective.

AS.02. CCTC Standard: Utilize best-practice protocols based upon animal behaviors for animal husbandry and welfare.

AS.02.01. Performance Indicator: Demonstrate management techniques that ensure animal welfare.

AS.02.02. Performance Indicator: Analyze procedures to ensure that animal products are safe for consumption (e.g., use in food system, etc.).

AS.03. CCTC Standard: Design and provide proper animal nutrition to achieve desired outcomes for performance, development, reproduction and/or economic production.

AS.03.01. Performance Indicator: Analyze the nutritional needs of animals.

AS.03.02 Performance Indicator: Analyze feed rations and assess if they meet the nutritional needs of animals.

AS.03.03 Performance Indicator: Utilize industry tools to make animal nutrition decisions.

AS.04. CCTC Standard: Apply principles of animal reproduction to achieve desired outcomes for performance, development and/or economic production.

AS.04.01. Performance Indicator: Evaluate animals for breeding readiness and soundness.

AS.04.02. Performance Indicator: Apply scientific principles to select and care for breeding animals.

AS.04.03 Performance Indicator: Apply scientific principles to breed animals.

AS.05. CCTC Standard: Evaluate environmental factors affecting animal performance and implement procedures for enhancing performance and animal health.

AS.05.01. Performance Indicator: Design animal housing, equipment and handling facilities for the major systems of animal production.

AS.05.02. Performance Indicator: Comply with government regulations and safety standards for facilities used in animal production.

AS.06. CCTC Standard: Classify, evaluate and select animals based on anatomical and physiological characteristics.

AS.06.01. Performance Indicator: Classify animals according to taxonomic classification systems and use (e.g. agricultural, companion, etc.).

AS.06.02. Performance Indicator: Apply principles of comparative anatomy and physiology to uses within various animal systems.

AS.06.03. Performance Indicator: Select and train animals for specific purposes and maximum performance based on anatomy and physiology.

AS.07. CCTC Standard: Apply principles of effective animal health care.

A**S.07.01. Performance Indicator:** Design programs to prevent animal diseases, parasites and other disorders and ensure animal welfare.

AS.07.02. Performance Indicator: Analyze biosecurity measures utilized to protect the welfare of animals on a local, state, national, and global level.

AS.08. CCTC Standard: Analyze environmental factors associated with animal production.

AS.08.01. Performance Indicator: Design and implement methods to reduce the effects of animal production on the environment.

AS.08.02. Performance Indicator: Evaluate the effects of environmental conditions on animals and create plans to ensure favorable environments for animals.

Common Career Technical Core Career Ready Practices Content Standards

The CCTC CRPs encompass fundamental skills and practices that all students should acquire to be career ready such as: responsibility, productivity, healthy choices, maintaining personal finances, communication, decision-making, creativity and innovation, critical-thinking, problem solving, integrity, ethical leadership, management, career planning, technology use and cultural/global competency. Students completing a program of study in any AFNR career pathway will demonstrate the knowledge, skills and behaviors that are important to career ready through experiences in a variety of settings (e.g., classroom, CTSO, work-based learning, community etc.).

DEFINITIONS: Within each pathway, the standards are organized as follows:

- ***Common Career Technical Core (CCTC) Standards*** – These are the standards for CRPs from the 2012 version of the Common Career and Technical Core Standards, which are owned by the National Association of State Directors of Career and Technical Education/National Career Technical Education Foundation and are used here with permission. These statements define what students should know and be able to do after completing instruction in a program of study for this pathway.
- ***Performance Indicators*** –These statements distill each CCTC Standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related CCTC Standard at the conclusion of a CTE program of study.

CRP.01. CCTC Standard: Act as a responsible and contributing citizen and employee.

CRP.01.01. Performance Indicator: Model personal responsibility in the workplace and community.

CRP.01.02 Performance Indicator: Evaluate and consider the near-term and long-term impacts of personal and professional decisions on employers and community before taking action.

CRP.01.03. Performance Indicator: Identify and act upon opportunities for professional and civic service at work and in the community.

CRP.02. CCTC Standard: Apply appropriate academic and technical skills.

CRP.02.01. Performance Indicator: Use strategic thinking to connect and apply academic learning, knowledge and skills to solve problems in the workplace and community.

CRP.02.02. Performance Indicator: Use strategic thinking to connect and apply technical concepts to solve problems in the workplace and community.

CRP.03. CCTC Standard: Attend to personal health and financial well-being.

CRP.03.01. Performance Indicator: Design and implement a personal wellness plan.

CRP.03.02. Performance Indicator: Design and implement a personal financial management plan.

CRP.04. CCTC Standard: Communicate clearly, effectively and with reason.

CRP.04.01. Performance Indicator: Speak using strategies that ensure clarity, logic, purpose and professionalism in formal and informal settings.

CRP.04.02. Performance Indicator: Produce clear, reasoned and coherent written and visual communication in formal and informal settings.

CRP.04.03. Performance Indicator: Model active listening strategies when interacting with others in formal and informal settings.

CRP.05. CCTC Standard: Consider the environmental, social and economic impacts of decisions.

CRP.05.01. Performance Indicator: Assess, identify and synthesize the information and resources needed to make decisions that positively impact the workplace and community.

CRP.05.02. Performance Indicator: Make, defend and evaluate decisions at work and in the community using information about the potential environmental, social and economic impacts.

CRP.06. CCTC Standard: Demonstrate creativity and innovation.

CRP.06.01. Performance Indicator: Synthesize information, knowledge and experience to generate original ideas and challenge assumptions in the workplace and community.

CRP.06.02. Performance Indicator: Assess a variety of workplace and community situations to identify ways to add value and improve the efficiency of processes and procedures.

CRP.06.03. Performance Indicator: Create and execute a plan of action to act upon new ideas and introduce innovations to workplace and community organizations.

CRP.07. CCTC Standard: Employ valid and reliable research strategies.

CRP.07.01. Performance Indicator: Select and implement reliable research processes and methods to generate data for decision-making in the workplace and community.

CRP.07.02. Performance Indicator: Evaluate the validity of sources and data used when considering the adoption of new technologies, practices and ideas in the workplace and community.

CRP.08. CCTC Standard: Utilize critical thinking to make sense of problems and persevere in solving them.

CRP.08.01. Performance Indicator: Apply reason and logic to evaluate workplace and community situations from multiple perspectives.

CRP.08.02. Performance Indicator: Investigate, prioritize and select solutions to solve problems in the workplace and community.

CRP.08.03. Performance Indicator: Establish plans to solve workplace and community problems and execute them with resiliency.

CRP.09. CCTC Standard: Model integrity, ethical leadership and effective management.

CRP.09.01. Performance Indicator: Model characteristics of ethical and effective leaders in the workplace and community (e.g. integrity, self-awareness, self-regulation, etc.).

CRP.09.02. Performance Indicator: Implement personal management skills to function effectively and efficiently in the workplace (e.g., time management, planning, prioritizing, etc.).

CRP.09.03. Performance Indicator: Demonstrate behaviors that contribute to a positive morale and culture in the workplace and community (e.g., positively influencing others, effectively communicating, etc.).

CRP.10. CCTC Standard: Plan education and career path aligned to personal goals.

CRP.10.01. Performance Indicator: Identify career opportunities within a career cluster that match personal interests, talents, goals and preferences.

CRP.10.02. Performance Indicator: Examine career advancement requirements (e.g., education, certification, training, etc.) and create goals for continuous growth in a chosen career.

CRP.10.03. Performance Indicator: Develop relationships with and assimilate input and/or advice from experts (e.g., counselors, mentors, etc.) to plan career and personal goals in a chosen career area.

CRP.10.04. Performance Indicator: Identify, prepare, update and improve the tools and skills necessary to pursue a chosen career path.

CRP.11. CCTC Standard: Use technology to enhance productivity.

CRP.11.01. Performance Indicator: Research, select and use new technologies, tools and applications to maximize productivity in the workplace and community.

CRP.11.02. Performance Indicator: Evaluate personal and organizational risks of technology use and take actions to prevent or minimize risks in the workplace and community.

CRP.12. CCTC Standard: Work productively in teams while using cultural/global competence.

CRP.12.01. Performance Indicator: Contribute to team-oriented projects and builds consensus to accomplish results using cultural global competence in the workplace and community.

CRP.12.02. Performance Indicator: Create and implement strategies to engage team members to work toward team and organizational goals in a variety of workplace and community situations (e.g., meetings, presentations, etc.).

Agriculture, Food, and Natural Resources Cluster Skill Content Standards

The AFNR Cluster Skills (CS) encompasses the study of fundamental knowledge and skills related to all AFNR professions. Students completing a program of study in any AFNR career

pathway will demonstrate fundamental knowledge of the nature, scope and relationships of AFNR systems and the skills necessary for analysis of current and historical issues and trends; application of technologies; safety, health and environmental practices; stewardship of natural resources; and exploration of career opportunities.

Within each pathway, the standards are organized as follows:

- ***Common Career Technical Core (CCTC) Standards*** – These are the standards for Agriculture, Food and Natural Resources Career Cluster® (AG) from the 2012 version of the Common Career and Technical Core Standards, which are owned by the National Association of State Directors of Career and Technical Education/National Career Technical Education Foundation and are used here with permission. These statements define what students should know and be able to do after completing instruction in a program of study for this pathway.
- ***Performance Indicators*** –These statements distill each CCTC Standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related CCTC Standard at the conclusion of a program of study in this area.

CS.01. CCTC Standard: Analyze how issues, trends, technologies and public policies impact systems in the Agriculture, Food & Natural Resources Career Cluster.

- **CS.01.01. Performance Indicator:** Research, examine and discuss issues and trends that impact AFNR systems on local, state, national and global levels.
- **CS.01.02. Performance Indicator:** Examine technologies and analyze their impact on AFNR systems.
- **CS.01.03. Performance Indicator:** Identify public policies and examine their impact on AFNR systems.

CS.02. CCTC Standard: Evaluate the nature and scope of the Agriculture, Food & Natural Resources Career Cluster and the role of agriculture, food and natural resources (AFNR) in society and the economy.

- **CS.02.01. Performance Indicator:** Research and use geographic and economic data to solve problems in AFNR systems.
- **CS.02.02. Performance Indicator:** Examine the components of the AFNR systems and assess their impact on the local, state, national and global society and economy.

CS.03. CCTC Standard: Examine and summarize the importance of health, safety and environmental management systems in AFNR workplaces.

- **CS.03.01. Performance Indicator:** Identify and explain the implications of required regulations to maintain and improve safety, health and environmental management systems.
- **CS.03.02. Performance Indicator:** Develop and implement a plan to maintain and improve health, safety and environmental compliance and performance.
- **CS.03.03. Performance Indicator:** Apply health and safety practices to AFNR workplaces.
- **CS.03.04. Performance Indicator:** Use appropriate protective equipment and demonstrate safe and proper use of AFNR tools and equipment.

CS.04. CCTC Standard: Demonstrate stewardship of natural resources in AFNR activities.
CS.04.01. Performance Indicator: Identify and implement practices to steward natural resources in different AFNR systems.
CS.04.02. Performance Indicator: Assess and explain the natural resource related trends, technologies and policies that impact AFNR systems.

CS.05. CCTC Standard: Describe career opportunities and means to achieve those opportunities in each of the Agriculture, Food & Natural Resources career pathways.
CS.05.01. Performance Indicator: Evaluate and implement the steps and requirements to pursue a career opportunity in each of the AFNR career pathways (e.g., goals, degrees, certifications, resumes, cover letter, portfolios, interviews, etc.).

CS.06. CCTC Standard: Analyze the interaction among AFNR systems in the production, processing and management of food, fiber and fuel and the sustainable use of natural resources.
CS.06.01. Performance Indicator: Examine and explain foundational cycles and systems of AFNR.
CS.06.02. Performance Indicator: Analyze and explain the connection and relationships between different AFNR systems on a national and global level.

Biotechnology Systems Career Pathway Content Standards

The Biotechnology Systems (BS) Career Pathway encompasses the study of using data and scientific techniques to solve problems concerning living organisms with an emphasis on applications to agriculture, food and natural resource systems. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the development, application and management of biotechnology in the context of AFNR.

Within each pathway, the standards are organized as follows:

- ***National Council for Agricultural Education (NCAE) Standard**** – These are the standards set forth by the National Council for Agricultural Education for Biotechnology Systems. They define what students should know and be able to do after completing instruction in a program of study focused on applying biotechnology to AFNR systems.
- ***Performance Indicators*** – These statements distill each performance element into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related performance element at the conclusion of a program of study in this area.

BS.01. NCAE Standard: Assess factors that have influenced the evolution of biotechnology in agriculture (e.g., historical events, societal trends, ethical and legal implications, etc.).
BS.01.01. **Performance Indicator**: Investigate and explain the relationship between past, current and emerging applications of biotechnology in agriculture (e.g., major innovators, historical developments, potential applications of biotechnology, etc.).

BS.01.02. Performance Indicator: Evaluate the scope and implications of regulatory agencies on applications of biotechnology in agriculture and protection of public interests (e.g., health, safety, environmental issues, etc.).

BS.01.03. Performance Indicator: Analyze the relationship and implications of bioethics, laws and public perceptions on applications of biotechnology in agriculture (e.g., ethical, legal, social, cultural issues).

BS.02. NCAE Standard: Demonstrate proficiency by safely applying appropriate laboratory skills to complete tasks in a biotechnology research and development environment (e.g., standard operating procedures, record keeping, aseptic technique, equipment maintenance, etc.).

BS.02.01. **Performance Indicator**: Read, document, evaluate and secure accurate laboratory records of experimental protocols, observations and results.

BS.02.02. Performance Indicator: Implement standard operating procedures for the proper maintenance, use and sterilization of equipment in a laboratory.

BS.02.03. Performance Indicator: Apply standard operating procedures for the safe handling of biological and chemical materials in a laboratory.

BS.02.04. Performance Indicator: Safely manage and dispose of biological materials, chemicals and wastes according to standard operating procedures.

BS.02.05. Performance Indicator: Examine and perform scientific procedures using microbes, DNA, RNA and proteins in a laboratory.

BS.03. NCAE Standard: Demonstrate the application of biotechnology to solve problems in Agriculture, Food and Natural Resources (AFNR) systems (e.g., bioengineering, food processing, waste management, horticulture, forestry, livestock, crops, etc.).

BS.03.01. Performance Indicator: Apply biotechnology principles, techniques and processes to create transgenic species through genetic engineering.

BS.03.02. Performance Indicator: Apply biotechnology principles, techniques and processes to enhance the production of food through the use of microorganisms and enzymes.

BS.03.03. Performance Indicator: Apply biotechnology principles, techniques and processes to protect the environment and maximize use of natural resources (e.g., biomass, bioprospecting, industrial biotechnology, etc.).

BS.03.04. Performance Indicator: Apply biotechnology principles, techniques and processes to enhance plant and animal care and production (e.g., selective breeding, pharmaceuticals, biodiversity, etc.).

BS.03.05. Performance Indicator: Apply biotechnology principles, techniques and processes to produce biofuels (e.g., fermentation, transesterification, methanogenesis, etc.).

BS.03.06. Performance Indicator: Apply biotechnology principles, techniques and processes to improve waste management (e.g., genetically modified organisms, bioremediation, etc.).

Environmental Service Systems Career Pathway Content Standards

The Environmental Service Systems (ESS) Career Pathway encompasses the study of systems, instruments and technology used to monitor and minimize the impact of human activity on environmental systems. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the development, application and management of environmental service systems in AFNR settings.

Within each pathway, the standards are organized as follows:

- ***Common Career Technical Core (CCTC) Standards*** – These are the standards for Environmental Service Systems (AG-ESS) from the 2012 version of the Common Career and Technical Core Standards, which are owned by the National Association of State Directors of Career and Technical Education/National Career Technical Education Foundation and are used here with permission. These statements define what students should know and be able to do after completing instruction in a program of study for this pathway.
- ***Performance Indicators*** – These statements distill each CCTC Standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related CCTC Standard at the conclusion of a program of study in this area.

ESS.01. CCTC Standard: Use analytical procedures and instruments to manage environmental service systems.

ESS.01.01. Performance Indicator: Analyze and interpret laboratory and field samples in environmental service systems.

ESS.01.02. Performance Indicator: Properly utilize scientific instruments in environmental monitoring situations (e.g., laboratory equipment, environmental monitoring instruments, etc.).

ESS.02. CCTC Standard: Evaluate the impact of public policies and regulations on environmental service system operations.

ESS.02.01. Performance Indicator: Interpret and evaluate the impact of laws, agencies, policies and practices affecting environmental service systems.

ESS.02.02. Performance Indicator: Compare and contrast the impact of current trends on regulation of environmental service systems (e.g., climate change, population growth, international trade, etc.).

ESS.02.03. Performance Indicator: Examine and summarize the impact of public perceptions and social movements on the regulation of environmental service systems.

ESS.03. CCTC Standard: Develop proposed solutions to environmental issues, problems and applications using scientific principles of meteorology, soil science, hydrology, microbiology, chemistry and ecology.

ESS.03.01. Performance Indicator: Apply meteorology principles to environmental service systems.

ESS.03.02. Performance Indicator: Apply soil science and hydrology principles to environmental service systems.

ESS.03.03. Performance Indicator: Apply chemistry principles to environmental service systems.

ESS.03.04. Performance Indicator: Apply microbiology principles to environmental service systems.

ESS.03.05. Performance Indicator: Apply ecology principles to environmental service systems.

ESS.04. CCTC Standard: Demonstrate the operation of environmental service systems (e.g., pollution control, water treatment, wastewater treatment, solid waste management and energy conservation).

ESS.04.01. Performance Indicator: Use pollution control measures to maintain a safe facility and environment.

ESS.04.02. Performance Indicator: Manage safe disposal of all categories of solid waste in environmental service systems.

ESS.04.03. Performance Indicator: Apply techniques to ensure a safe supply of drinking water and adequate treatment of wastewater according to applicable rules and regulations.

ESS.04.04. Performance Indicator: Compare and contrast the impact of conventional and alternative energy sources on the environment and operation of environmental service systems.

ESS.05. CCTC Standard: Use tools, equipment, machinery and technology common to tasks in environmental service systems.

ESS.05.01. Performance Indicator: Use technological and mathematical tools to map land, facilities and infrastructure for environmental service systems.

ESS.05.02. Performance Indicator: Perform assessments of environmental conditions using equipment, machinery and technology.

Food Products and Processing Systems Career Pathway Content Standards

The Food Products and Processing Systems (FPP) Career Pathway encompasses the study of food safety and sanitation; nutrition, biology, microbiology, chemistry and human behavior in local and global food systems; food selection and processing for storage, distribution and consumption; and the historical and current development of the food industry. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the development, application and management of food products and processing systems in AFNR settings.

Within each pathway, the standards are organized as follows:

- ***Common Career Technical Core (CCTC) Standards*** – These are the standards for Food Products and Processing Systems (AG-FPP) from the 2012 version of the Common Career and Technical Core Standards, which are owned by the National Association of State Directors of Career and Technical Education/National Career Technical Education Foundation and are used here with permission. These statements define what students should know and be able to do after completing instruction in a program of study for this pathway.
- ***Performance Indicators*** – These statements distill each CCTC Standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to

demonstrate an acceptable level of proficiency with the related CCTC Standard at the conclusion of a program of study in this area.

FPP.01. CCTC Standard: Develop and implement procedures to ensure safety, sanitation and quality in food product and processing facilities.

FPP.01.01. Performance Indicator: Analyze and manage operational and safety procedures in food products and processing facilities.

FPP.01.02. Performance Indicator: Apply food safety and sanitation procedures in the handling and processing of food products to ensure food quality.

FPP.01.03. Performance Indicator: Apply food safety procedures when storing food products to ensure food quality.

FPP.02. CCTC Standard: Apply principles of nutrition, biology, microbiology, chemistry and human behavior to the development of food products.

FPP.02.01. Performance Indicator: Apply principles of nutrition and biology to develop food products that provide a safe, wholesome and nutritious food supply for local and global food systems.

FPP.02.02. Performance Indicator: Apply principles of microbiology and chemistry to develop food products to provide a safe, wholesome and nutritious food supply for local and global food systems.

FPP.02.03. Performance Indicator: Apply principles of human behavior to develop food products to provide a safe, wholesome and nutritious food supply for local and global food systems.

FPP.03. CCTC Standard: Select and process food products for storage, distribution and consumption.

FPP.03.01. Performance Indicator: Implement selection, evaluation and inspection techniques to ensure safe and quality food products.

FPP.03.02. Performance Indicator: Design and apply techniques of food processing, preservation, packaging and presentation for distribution and consumption of food products.

FPP.03.03. Performance Indicator: Create food distribution plans and procedures to ensure safe delivery of food products.

FPP.04. CCTC Standard: Explain the scope of the food industry and the historical and current developments of food product and processing.

FPP.04.01. Performance Indicator: Examine the scope of the food industry by evaluating local and global policies, trends and customs for food production.

FPP.04.02. Performance Indicator: Evaluate the significance and implications of changes and trends in the food products and processing industry in the local and global food systems.

FPP.04.03. Performance Indicator: Identify and explain the purpose of industry organizations, groups and regulatory agencies that influence the local and global food systems.

Natural Resource Systems Career Pathway Content Standards

The Natural Resource Systems (NRS) Career Pathway encompasses the study of the management, protection, enhancement and improvement of soil, water, wildlife, forests and air as natural resources. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the development, application and management of natural resource systems in AFNR settings.

Within each pathway, the standards are organized as follows:

- ***Common Career Technical Core (CCTC) Standards*** – These are the standards for Natural Resource Systems (AG-NRS) from the 2012 version of the Common Career and Technical Core Standards, which are owned by the National Association of State Directors of Career and Technical Education/National Career Technical Education Foundation and are used here with permission. These statements define what students should know and be able to do after completing instruction in a program of study for this pathway.
- ***Performance Indicators*** – These statements distill each CCTC Standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related CCTC Standard at the conclusion of a program of study in this area.

NRS.01. CCTC Standard: Plan and conduct natural resource management activities that apply logical, reasoned and scientifically based solutions to natural resource issues and goals.

NRS.01.01. Performance Indicator: Apply methods of classification to examine natural resource availability and ecosystem function in a particular region.

NRS.01.02. Performance Indicator: Classify different types of natural resources in order to enable protection, conservation, enhancement and management in a particular geographical region.

NRS.01.03. Performance Indicator: Apply ecological concepts and principles to atmospheric natural resource systems.

NRS.01.04. Performance Indicator: Apply ecological concepts and principles to aquatic natural resource systems.

NRS.01.05. Performance Indicator: Apply ecological concepts and principles to terrestrial natural resource systems.

NRS.01.06. Performance Indicator: Apply ecological concepts and principles to living organisms in natural resource systems.

NRS.02. CCTC Standard: Analyze the interrelationships between natural resources and humans.

NRS.02.01. Performance Indicator: Examine and interpret the purpose, enforcement, impact and effectiveness of laws and agencies related to natural resource management, protection, enhancement and improvement (e.g., water regulations, game laws, historic preservation laws, environmental policy, etc.).

NRS.02.02. Performance Indicator: Assess the impact of human activities on the availability of natural resources.

NRS.02.03. Performance Indicator: Analyze how modern perceptions of natural resource management, protection, enhancement and improvement change and develop over time.

NRS.02.04. Performance Indicator: Examine and explain how economics affects the use of natural resources.

NRS.02.05. Performance Indicator: Communicate information to the public regarding topics related to the management, protection, enhancement, and improvement of natural resources.

NRS.03. CCTC Standard: Develop plans to ensure sustainable production and processing of natural resources.

NRS.03.01. Performance Indicator: Sustainably produce, harvest, process and use natural resource products (e.g., forest products, wildlife, minerals, fossil fuels, shale oil, alternative energy, recreation, aquatic species, etc.).

NRS.03.02. Performance Indicator: Demonstrate cartographic skills, tools and technologies to aid in developing, implementing and evaluating natural resource management plans.

NRS.04. CCTC Standard: Demonstrate responsible management procedures and techniques to protect, maintain, enhance, and improve natural resources.

NRS.04.01. Performance Indicator: Demonstrate natural resource protection, maintenance, enhancement and improvement techniques.

NRS.04.02. Performance Indicator: Diagnose plant and wildlife diseases and follow protocols to prevent their spread.

NRS.04.03. Performance Indicator: Prevent or manage introduction of ecologically harmful species in a particular region.

NRS.04.04. Performance Indicator: Manage fires in natural resource systems.

Plant Science Systems Career Pathway Content Standards

The Plant Systems (PS) Career Pathway encompasses the study of plant life cycles, classifications, functions, structures, reproduction, media and nutrients, as wells as growth and cultural practices through the study of crops, turf grass, trees, shrubs and/or ornamental plants. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the development, application and management of plant systems in AFNR settings.

Within each pathway, the standards are organized as follows:

- ***Common Career Technical Core (CCTC) Standards*** – These are the standards for Plant Systems (AG-PS) from the 2012 version of the Common Career and Technical Core Standards, which are owned by the National Association of State Directors of Career and Technical Education/National Career Technical Education Foundation and are used here with permission. These statements define what students should know and be able to do after completing instruction in a program of study for this pathway.
- ***Performance Indicators*** – These statements distill each CCTC Standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related CCTC Standard at the conclusion of a program of study in this area.

PS.01. CCTC Standard: Develop and implement a crop management plan for a given production goal that accounts for environmental factors.

- **PS.01.01. Performance Indicator:** Determine the influence of environmental factors on plant growth.
- **PS.01.02. Performance Indicator:** Prepare and manage growing media for use in plant systems.
- **PS.01.03. Performance Indicator:** Develop and implement a fertilization plan for specific plants or crops.

PS.02. CCTC Standard: Apply principles of classification, plant anatomy, and plant physiology to plant production and management.

- **PS.02.01. Performance Indicator:** Classify plants according to taxonomic systems.
- **PS.02.02. Performance Indicator:** Apply knowledge of plant anatomy and the functions of plant structures to activities associated with plant systems.
- **PS.02.03. Performance Indicator:** Apply knowledge of plant physiology and energy conversion to plant systems.

PS.03. CCTC Standard: Propagate, culture and harvest plants and plant products based on current industry standards.

- **PS.03.01. Performance Indicator:** Demonstrate plant propagation techniques in plant system activities.
- **PS.03.02. Performance Indicator:** Develop and implement a management plan for plant production.
- **PS.03.03. Performance Indicator:** Develop and implement a plan for integrated pest management for plant production.
- **PS.03.04. Performance Indicator:** Apply principles and practices of sustainable agriculture to plant production.
- **PS.03.05. Performance Indicator:** Harvest, handle and store crops according to current industry standards.

PS.04. CCTC Standard: Apply principles of design in plant systems to enhance an environment (e.g. floral, forest landscape, and farm).

- **PS.04.01. Performance Indicator:** Evaluating, identifying and preparing plants to enhance an environment.
- **PS.04.02. Performance Indicator:** Create designs using plants.

Power, Structural and Technical Systems Career Pathway Content Standards

The Power, Structural and Technical Systems (PST) Career Pathway encompasses the study of agricultural equipment, power systems, alternative fuel sources and precision technology, as well as woodworking, metalworking, welding and project planning for agricultural structures. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the development, application and management of power, structural and technical systems in AFNR settings.

Within each pathway, the standards are organized as follows:

- ***Common Career Technical Core (CCTC) Standards*** – These are the standards for Power, Structural and Technical Systems (AG-PST) from the 2012 version of the Common Career and Technical Core Standards, which are owned by the National Association of State Directors of Career and Technical Education/National Career Technical Education Foundation and are used here with permission. These statements define what students should know and be able to do after completing instruction in a program of study for this pathway.
- ***Performance Indicators*** – These statements distill each CCTC Standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related CCTC Standard at the conclusion of a program of study in this area.

PST.01. CCTC Standard: Apply physical science principles and engineering applications to solve problems and improve performance in AFNR power, structural and technical systems.

PST.01.01. Performance Indicator: Apply physical science and engineering principles to assess and select energy sources for AFNR power, structural and technical systems.

PST.01.02. Performance Indicator: Apply physical science and engineering principles to design, implement and improve safe and efficient mechanical systems in AFNR situations.

PST.01.03. Performance Indicator: Apply physical science principles to metal fabrication using a variety of welding and cutting processes (e.g., SMAW, GMAW, GTAW, fuel-oxygen and plasma arc torch, etc.).

PST.02. CCTC Standard: Operate and maintain AFNR mechanical equipment and power systems.

PST.02.01. Performance Indicator: Perform preventative maintenance and scheduled service to maintain equipment, machinery and power units used in AFNR settings.

PST.02.02. Performance Indicator: Operate machinery and equipment while observing all safety precautions in AFNR settings.

PST.03. CCTC Standard: Service and repair AFNR mechanical equipment and power systems.

PST.03.01. Performance Indicator: Troubleshoot, service and repair components of internal combustion engines using manufacturers' guidelines.

PST.03.02. Performance Indicator: Service electrical systems and components of mechanical equipment and power systems using a variety of troubleshooting and/or diagnostic methods.

PST.03.03. Performance Indicator: Utilize manufacturers' guidelines to diagnose and troubleshoot malfunctions in machinery, equipment and power source systems (e.g., hydraulic, pneumatic, transmission, steering, suspension, etc.).

PST.04. CCTC Standard: Plan, build and maintain AFNR structures.

PST.04.01. Performance Indicator: Create sketches and plans for AFNR structures.

PST.04.02. Performance Indicator: Determine structural requirements, specifications and estimate costs for AFNR structures

PST.04.03. Performance Indicator: Follow architectural and mechanical plans to construct, maintain and/or repair AFNR structures (e.g., material selection, site preparation and/or layout, plumbing, concrete/masonry, etc.).

PST.04.04. Performance Indicator: Apply electrical wiring principles in AFNR structures.

PST.05. CCTC Standard: Use control, monitoring, geospatial and other technologies in AFNR power, structural and technical systems.

PST.05.01. Performance Indicator: Apply computer and other technologies (e.g., robotics, CNC, UAS, etc.) to solve problems and increase the efficiency of AFNR systems.

PST.05.02. Performance Indicator: Prepare and/or use electrical drawings to design, install and troubleshoot electronic control systems in AFNR settings.

PST.05.03. Performance Indicator: Apply geospatial technologies to solve problems and increase the efficiency of AFNR systems.